MACHINE DESIGN

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Including 23 regular issues of MACHINE DESIGN plus five special issues—*The Materials Reference Issue, Electrical & Electronics Reference Issue, Mechanical Drives Reference Issue, Fluid Power Reference Issue, Fastening & Joining Reference Issue.* Only articles and editorial items one-half page or larger are indexed.

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(1) Title.

(2) Author's last name (see AUTHOR INDEX for full name).
Departments in regular issues are denoted by the codes:

N/T ..... News/Trends
DI ..... Design International
Scan ..... Scanning the Field for Ideas

Articles in MACHINE DESIGN *Reference Issues* are identified by the entry:
Chapter (*Ref. Issue* code).
Reference Issues are coded as follows:

M ..... Materials
E&E ..... Electrical & Electronics
MD ..... Mechanical Drives
FP ..... Fluid Power
F&J ..... Fastening & Joining

(3) Date of regular or *Reference* issue.
(4) Page number.
(5) Number of pages in article or item.

ELECTRICAL & ELECTRONIC

11. Motors

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Micromotors Measure Minitorques	Dumas	3/24	95	(1.5)
New Breed of DC Motors	Bahm	2/10	97	(5.0)
Hotrodding Capacitor Motors	Ander	5/12	88	(3.0)
Energy Miser Now Controls Any DC Motor	Krouse	1/6	79	(4.0)
New Breed of DC Motors	Bahm	2/10	97	(5.0)
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Battery-Like Solar Cell Promises Cheap Power	N/T	8/25	6	(0.8)
Simple Switches Safeguard Motor-Driven Pot	Scan	2/24	39	(0.5)
Servo Drives For Machine Tools	Jones	4/21	270	(2.3)
Eddy-Current Coupling Competes With DC Drives	Scan	11/24	38	(0.5)

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Man Touches Display Panel To Communicate With Machine	N/T	4/21	8	(1.3)
Servo Drives For Machine Tools	Jones	4/21	270	(2.3)
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Fire Detector Checks Up On Itself	Scan	1/20	44	(0.5)
New Noncontact Sensors Detect Anything, Operate Anywhere	Engstrom	3/10	67	(3.0)
Spaced-Out Sensors Simplify Torque Wrench	Scan	4/21	70	(0.6)

Keeping Tachometers Honest	Wickens	6/9	107	(3.0)
Piezoelectric Sleeve Regulates Gas Flow	Scan	6/23	38	(0.5)
Tiny Wires Generate Big Pulses	Scan	6/23	42	(1.0)
Sensor Helps Fine Tune Air-Fuel Ratios	Scan	7/21	42	(0.7)
Corrosion Detector Simulates Battery	Scan	9/22	40	(0.5)
Bidirectional Torque Transducer Needs No Slip Rings	Scan	10/6	44	(0.5)
Sensing Speed For Control and Measurement	Jasik	10/20	168	(4.0)
Strain-Gage Pressure Transducers	Tolliver	11/10	123	(5.0)
Current Sensors Close the Loop in Stepper Controls	Article	11/10	147	(1.3)
Fatigue Monitor 'Freezes' Peak Loads	Scan	11/24	40	(0.6)
Pressure Transducer Ignores High Temperatures	Scan	12/8	58	(0.5)
Thick-Film Resistors for Kilovolt Circuits	Lockert	12/8	156	(5.0)
Designing PM Linear Actuators	Bleeke	4/21	265	(4.0)
Process Makes New Solid State Devices Economical	N/T	6/9	4	(0.7)
Protecting Power Semiconductors	Article	6/9	110	(1.7)
Simple Zero-Voltage Switching Circuit	Gross	6/23	104	(1.6)
Six Rules For Preventing 'Burn Out' In Power Transistors	Bixby & Mickelopoulos	11/24	90	(5.0)
Heat Pipes Cool SCR	Scan	12/8	58	(0.5)
Square Beam Makes Semiconductors Without Masks	Scan	2/10	42	(0.5)
Architecture: Key To Microprocessor Performance	Morris, Patel & Schwartz	2/10	108	(4.0)
Bubble Memory Put To Work	N/T	2/24	4	(1.0)
Microprocessor Simplifies Multi-Axis Machine Control	Scan	2/24	41	(0.7)
The Case For Custom Circuits	Mingione	2/24	84	(5.0)
Weeding Out Defective ICs	Leonard	3/10	74	(5.0)
The Electronic Memory	Stern	4/7	65	(7.0)
Video Games: Playing For Bigger Stakes	Wise	4/21	30	(6.0)
The Incredible Shrinking Circuit	Comella	4/21	212	(6.0)
Microprocessors: Beyond the Price Tag	Harding	5/12	71	(5.0)
Computing IC Temperature Rise	Emerald & Dewey	6/9	98	(4.0)
New ICs Simplify Machine Control	Hickey & Munn	7/21	112	(7.0)
Computerized Green Thumb for Hands-Off Farming	Scan	8/11	42	(1.0)
When Custom LSI Can Save You Money	Koury	8/11	91	(5.0)
How To Eliminate Premature Semiconductor Failures	Schmid	8/25	80	(3.0)
Getting Started in μP Control: Up-Front Costs	Harding	9/22	87	(5.0)
Tradeoffs in Microcomputer Design	Russo	9/22	113	(2.0)
IC With 'Eyes' Keeps Camera in Focus	Scan	12/8	56	(1.0)
Two-Way Amplifier Boosts Signals in Long Lines	Scan	11/24	38	(0.5)
Relays That Fight EMI	Bishop	1/20	118	(5.0)
Spinning Styli Print Messages on the Fly	Scan	4/21	62	(1.0)
Fatigue Monitor 'Freezes' Peak Loads	Scan	11/24	40	(0.6)
Magnetic Inserts Stabilize Stepper Motor	Scan	7/7	36	(1.0)
Controlling Machines By Ear	Krouse	10/20	146	(6.0)
Regulating Temperature With Proportional Control	Eckert	10/20	194	(2.0)
Are We Girding For 'Laser Wars' In Space?	Zimmerman	12/8	20	(6.0)
Heel-and-Tow Wiring Terminal Ends Rat's Nest	Scan	10/6	46	(0.5)
Inserts Convert PC Through Holes To Plug-In Sockets	Scan	1/20	46	(0.5)
Spring-Loaded Shutters Make Simple Safety Outlet	Scan	3/24	38	(0.5)
Terminal Block Ratings	Van Der Elsen	4/7	83	(3.0)
Permanent Lubrication Looking Good For All Electrical-Connector Configurations	N/T	5/26	8	(0.7)
Lipped Contacts Protect PC Pads	Scan	6/23	38	(0.5)
Plug-In Contacts Produce Custom Connectors	Scan	9/22	38	(1.0)
Tiny Transformers Improve Connector Reliability	Scan	10/6	46	(0.5)
Temperature Rise in Electronic Circuits	Steinberg	1/20	130	(3.0)
Sizing PCB Conductors	Rondeau	1/20	144	(1.4)
Snubbers Calm PCB Vibration	Steinberg	3/24	71	(3.0)
Taking the Shake Out of Circuit Boards	Steinberg	9/22	96	(4.0)
Temperature Rise in Electronic Circuits	Steinberg	1/20	130	(3.0)
Sizing PCB Conductors	Rondeau	1/20	144	(1.4)
Snubbers Calm PCB Vibration	Steinberg	3/24	71	(3.0)
Taking the Shake Out of Circuit Boards	Steinberg	9/22	96	(4.0)

15, 16. Circuit Components, Connectors & Wiring

From Logic to Hardware	Leonard & Krouse	9/8	120	(8.0)
Molded Plastic Magnets	Theberge, Arkles & Knabb	2/10	112	(5.0)
Collapsing Field Straightens Dented Metal	Scan	4/7	42	(0.6)
Thick-Film Resistors For Kilovolt Circuits	Lockert	12/8	156	(5.0)
Stable and Easily Formed Fabric for Magnetic Shielding	N/T	4/21	6	(0.6)
RF Generator Miniaturizes Fluorescent Lamp	Scan	10/20	54	(0.5)
Energy Miser Now Controls Any DC Motor	Krouse	1/6	79	(4.0)
Square Beam Makes Semiconductors Without Masks	Scan	2/10	42	(0.5)
Bubble Memory Put To Work	N/T	2/24	4	(1.0)
The Case For Custom Circuits	Mingione	2/24	84	(5.0)
Weeding Out Defective ICs	Leonard	3/10	74	(5.0)
Furnace Retrofits Not Yet Proven Safe	N/T	4/7	12	(0.5)
The Electronic Memory	Stern	4/7	65	(7.0)
Video Games: Playing For Bigger Stakes	Wise	4/21	30	(6.0)
The Incredible Shrinking Circuit	Comella	4/21	212	(6.0)
Solid-State Switching Devices	Chapter E&E	5/19	200	(21.0)
New ICs Simplify Machine Control	Hickey & Munn	7/21	112	(7.0)
When Custom LSI Can Save You Money	Koury	8/11	91	(5.0)
How To Eliminate Premature Semiconductor Failures	Schmid	8/25	80	(3.0)
Our Unassailable Lead in Electronics	Leonard & Krouse	10/6	111	(9.0)
Two-Way Amplifier Boosts Signals in Long Lines	Scan	11/24	38	(0.5)
Six Rules for Preventing 'Burn Out' in Power Transistors	Bixby & Michelopoulos	11/24	90	(5.0)
IC With 'Eyes' Keeps Camera in Focus	Scan	12/8	56	(1.0)
Heat Pipes Cool SCR	Scan	12/8	58	(0.5)
A Simple Approach to Cooling Hot ICs With Heat Sinks	Adamian	5/26	106	(4.0)
Coping With Cable Capacitance in 3-0 GFIs	Gross	9/22	115	(2.0)
Optical Sliprings Transmit Light Signals	Scan	8/25	44	(0.6)
Are We Girding For 'Laser Wars' In Space?	Zimmerman	12/8	20	(6.0)
Interconnections	Chapter E&E	5/19	277	(8.5)
Terminal Block Ratings	Van Der Elsen	4/7	83	(3.0)

17. Miscellaneous Components

Pinpointing Potential Electronic System Failures	Kivenko	4/7	86	(1.7)
Machine Controllers	Chapter E&E	5/19	232	(14.5)
Molded Plastic Magnets	Theberge, Arkles & Knabb	2/10	112	(5.0)
Collapsing Field Straightens Dented Metal	Scan	4/7	42	(0.6)
Man Touches Display Panel To Communicate With Machine	N/T	4/21	8	(1.3)
Stable and Easily Formed Fabric for Magnetic Shielding	N/T	4/21	6	(0.6)
Electrical & Electronic Devices 1977	Chapter E&E	5/19	2	(4.0)
Optical Sliprings Transmit Light Signals	Scan	8/25	44	(0.6)
RF Generator Miniaturizes Fluorescent Lamp	Scan	10/20	54	(0.5)
Furnace Retrofits Not Yet Proven Safe	N/T	4/7	12	(0.5)
Probe Finds Computer Bottlenecks	Zussman	12/8	190	(1.8)
Taking the Mystery Out of Micros	Roybal	3/24	80	(4.0)
Insulation Salesman Carries a Computer	N/T	10/6	4	(1.0)
Stripping the Mystery from Microcomputers	Teschler	12/8	161	(10.0)
Electrostatic Ignition Fires Ultralean Fuel Mixtures	Scan	5/26	42	(0.6)
Wiegand Effect Simplifies Automotive Ignition Circuitry	N/T	8/11	6	(0.6)
Controlling Machines By Ear	Krouse	10/20	146	(6.0)
Regulating Temperature With Proportional Control	Eckert	10/20	194	(2.0)
Converter Circuit Stops Ni-Cd Cell Reversal	Scan	2/24	39	(0.5)
'Photochemical Diodes Simulate Photosynthesis	N/T	3/10	6	(0.8)
Battery of 9-V Size Is Rechargeable	N/T	7/21	8	(0.5)
Snap-On Reservoir Refills Storage Batteries	Scan	8/25	42	(0.7)
Compact Battery Packs a Wallop	Scan	9/8	52	(0.6)
Operating Life Doubled for Button Cell	N/T	9/22	10	(0.7)
Fuel Cells—A Sleeper in the Energy Race	Aronson	2/24	20	(4.0)
Battery-Like Solar Cell Promises Cheap Power	N/T	8/25	6	(0.8)
Inverting Low DC Voltages	Gross	7/7	93	(1.0)

19. Systems & Assemblies

Pinpointing Potential Electronic System Failures	Kivenko	4/7	86	(1.7)
Machine Controllers	Chapter E&E	5/19	232	(14.5)
Coming: Integrated Computer Aided Manufacturing	N/T	2/24	26	(0.5)
RPV Flys Automatic Flight	N/T	1/6	8	(0.8)
Electrical & Electronic Devices 1977	Chapter E&E	5/19	6	(4.0)
Coming: Integrated Computer Aided Manufacturing	N/T	2/24	26	(0.5)
Calculators, Portable Computers—Personal Problem-Solvers	Comella	2/24	118	(5.0)
How To Make Your Calculator Think Like A Computer	Levy	3/10	62	(5.0)
Taking the Mystery Out of Micros	Roybal	3/24	80	(4.0)
Program Finds Equation Roots	Pierce	4/7	87	(1.0)
Spinning Styli Print Messages on the Fly	Scan	4/21	62	(1.0)
Laser Writes 'Typing' on Display Screen	N/T	6/9	8	(0.8)
Before Buying A Micro, Read The Menu	Biewer	7/7	68	(7.0)
Insulation Salesman Carries a Computer	N/T	10/6	4	(1.0)
Printers With A Soft Touch	Miller	10/20	40	(4.0)
Simple Page Printer Runs Sideways	Scan	11/10	49	(1.0)
Probe Finds Computer Bottlenecks	Zussman	12/8	190	(1.8)
Boosting Microprocessor Speed	Hilford	1/6	70	(5.0)
Architecture: Key To Microprocessor Performance	Morris, Patel & Schwartz	2/10	108	(4.0)
Microprocessor Simplifies Multi-Axis Machine Control	Scan	2/24	41	(0.7)
Before Buying A Micro, Read The Menu	Biewer	7/7	68	(7.0)
Getting Started in μP Control: Up-Front Costs	Harding	9/22	87	(5.0)
Tradeoffs in Microcomputer Design	Russo	9/22	113	(2.0)
Calculators, Portable Computers—Personal Problem-Solvers	Comella	2/24	118	(5.0)
How To Make Your Calculator Think Like A Computer	Levy	3/10	62	(5.0)
Program Finds Equation Roots	Pierce	4/7	87	(1.0)
Eddy-Current Coupling Competes With DC Drives	Scan	11/24	38	(0.5)

FLUID POWER

21, 22, 23. Fluids, Fluid Conditioners, Fluid Conductors

Liquid Ohms Simplify Flow Calucations	Reynolds	7/7	92	(2.0)
Fluid Systems 1977	Chapter FP	9/29	2	(5.0)
Will Washington Write Fluid-Power Standards?	Article	10/20	183	(2.0)
Fluids	Chapter FP	9/29	131	(4.0)
Are Synthetic Fluids Hazardous to Health?	N/T	2/24	18	(1.0)
'Sea Serpent' To Store the Navy's Fuel	N/T	6/9	6	(0.5)
Wedge-Shaped Wire Cuts Filter Clogging	Scan	1/6	40	(0.5)
Wire-Mesh Filters	Mason	3/24	84	(5.0)
Dual Filters Isolate Bearing and Lubrication Temperatures	Scan	9/22	40	(0.5)
Hydraulic and Pneumatic Filters	Chapter FP	9/29	150	(2.6)
Double-Wall Exhaust Stack Recovers Lost Heat	Scan	4/21	66	(0.6)
Heat Exchangers	Chapter FP	9/29	156	(2.7)
Pipe and Tubing	Chapter FP	9/29	136	(1.5)
Tube Fittings	Chapter FP	9/29	138	(2.0)
Hydraulic Hose	Chapter FP	9/29	143	(0.7)
Hose Fittings	Chapter FP	9/29	144	(2.0)
The Right Way to Select Quick Disconnects	Wilcox	8/11	86	(5.0)

24. Linear Devices

NC Cylinder Positions Heavy Loads at High Speed	N/T	7/21	40	(1.0)
Self-Controlled Cylinder Simplifies Servo Systems	Scan	9/22	44	(1.0)
Cylinders	Chapter FP	9/29	187	(4.9)
Using Accumulators To Smooth Hydraulic Transients	Zahid	7/7	75	(3.0)
Cryogenic Accumulator Supplies Its Own Gas	Scan	9/22	42	(0.5)
Accumulators	Chapter FP	9/29	16	(1.8)
Compressor Lets Gas Boost Its Own Pressure	Scan	3/24	40	(0.6)
Pump Puts Water Hammer To Work	Scan	5/26	40	(0.6)
Picking the Right Booster	Chapter FP	9/29	20	(1.0)
Hydraulic Brakes Run on Air	Scan	7/21	44	(0.6)

25. Rotary Devices

Choosing the Right Vacuum Pump	Brooks	1/6	83	(5.0)
Nested Cones Pump Blood in Artificial Heart	Scan	2/10	44	(0.5)
Pump Controls That Save Energy	Sculthorpe	4/21	255	(5.0)
Pushrods Power Pump Vanes	Scan	7/21	46	(0.5)
How Pumps Work	Chapter FP	9/29	9	(3.3)
Choosing a Hydraulic Pump	Chapter FP	9/29	12	(3.0)
Centrifugal Pumps	Chapter FP	9/29	273	(2.0)
Positive-Displacement Pumps	Chapter FP	9/29	276	(3.5)
Which Type of Fluid Motor?	Chapter FP	9/29	202	(2.3)
CO_2-Operated Motor Delivers Big Kick	Scan	10/20	52	(1.0)
Counterbalanced Air Compressor Stops the Shakes	Scan	6/9	44	(0.6)
Forgotten Factors in Compressor Selection	Brooks	6/23	94	(4.0)
Compressors	Chapter FP	9/29	22	(1.3)
Vacuum Pumps	Chapter FP	9/29	28	(1.7)
Threaded Piston Propels Rotary Actuator	Scan	8/25	46	(0.5)
Rotary Pneumatic and Hydraulic Actuators	Chapter FP	9/29	200	(1.4)

26. Seals

New Metric Port Standard Has Universal Appeal	Dann	5/12	82	(2.0)
Where Balanced Face Seals Pay Off	Fazekas & Kosec	6/9	89	(4.0)
Face Seals	Chapter MD	6/30	261	(3.3)
Radial Lip Seals	Chapter MD	6/30	264	(3.4)
Exclusion Devices	Chapter MD	6/30	267	(1.3)
Circumferential Seals	Chapter MD	6/30	270	(2.1)
Split Ring Seals	Chapter MD	6/30	276	(1.0)
Compression Packings	Chapter MD	6/30	278	(2.4)
Lip Packings	Chapter MD	6/30	283	(1.4)
Squeeze Packings	Chapter MD	6/30	286	(2.6)
Felt Radial Seals	Chapter MD	6/30	288	(1.7)
Diaphragm Seals	Chapter MD	6/30	290	(0.7)
Nonmetallic Gaskets	Chapter MD	6/30	291	(1.6)
Metallic Gaskets	Chapter MD	6/30	293	(2.7)
Pressure-Energized Seals	Chapter FP	9/29	235	(2.3)
O-Rings and Other Squeeze Packings	Chapter FP	9/29	238	(1.9)
Exclusion Seals	Chapter FP	9/29	242	(1.1)
Compression Packings and Seals	Chapter FP	9/29	244	(1.5)
Seal Selection: Beyond "Standard Practice"	Ratelle	1/20	133	(5.0)
Plunger Puts O-Rings In Their Place	Scan	3/24	38	(0.5)
Sealing Rotary Shafts With O-Rings	Martini	5/26	97	(3.0)
Preloaded Ring Seals Fiery Fluids	Scan	10/20	54	(0.5)
How Much Pressure Will That Gasket Take?	Swick	11/24	86	(4.0)
Valve Packings That Don't Leak	Ezekoye & George	1/20	142	(2.0)
Inflated Bellows Steadies Fluid Delivery Rate	Scan	1/20	42	(0.7)
Pressure Plug Checks Pipe Welds	Scan	6/9	46	(0.5)

27. Valves

Fluid-Handling Valves	Chapter FP	9/29	280	(3.5)
Pneumatic Reed Switch Runs on Digital Logic	Scan	9/8	50	(1.0)
How Valves Answer Commands	Chapter FP	9/29	76	(2.0)
Putting Valves in Circuits	Chapter FP	9/29	78	(0.7)
Selecting Direction-Control Valves?	Chapter FP	9/29	78	(1.7)
Inflated Bellows Steadies Fluid Delivery Rate	Scan	1/20	42	(0.7)
Eccentric Ball Prolongs Valve Life	Scan	5/12	42	(0.5)
Controlling Hydraulic Pressure and Flow	Chapter FP	9/29	82	(3.5)
Controlling Air Pressure	Chapter FP	9/29	88	(0.7)
Servovalve Simplifies Hydraulic Control	Scan	5/26	38	(1.0)
Servovalve for Ultimate Accuracy	Chapter FP	9/29	86	(1.3)

MECHANICAL

28. Instruments & Controls

Density Meter Does Pressure Balancing Act	Scan	1/20	46	(0.5)
Turbulence Meter Keeps Optical Systems on the Straight and Narrow	Scan	2/10	44	(0.5)
Floating Flowmeter Ends Bearing Drag	Scan	8/11	44	(0.5)
Gaging Fluid System Performance	Chapter FP	9/29	90	(4.0)
Build Your Own Flowmeter	Scan	10/6	48	(0.7)
Monitor Your Fuel Oil Like They Do on the 18-Wheelers	Scan	4/21	64	(0.5)
Moving-Part Logic	Chapter FP	9/29	296	(2.0)
Fluidics	Chapter FP	9/29	298	(1.7)

29. Systems & Assemblies

Keeping Gremlins Out of Hydraulic Systems	Henke	3/10	70	(4.0)
Simple Techniques Reduce Pneumatic Noise	Article	8/25	98	(1.7)
Power Units	Chapter FP	9/29	16	(0.7)
Closed-Loop Control Silences Hydraulic Press	Scan	12/8	62	(0.6)
Simple Hydraulics Give Steering System a Boost	Scan	4/21	64	(0.5)
Hydraulic Load Sensor Eliminates Headlight "Dazzle"	Scan	8/25	48	(1.0)
Hydrostatics Tackle Tough New Jobs	Klein & Norris	8/25	83	(5.0)
Hydrostatic Drives	Chapter FP	9/29	210	(2.0)
Choosing the Right Vacuum Pump	Brooks	1/6	83	(5.0)
Banded Disc Aids Lubrication Studies	Scan	1/20	45	(0.5)
Hydraulic Drive Overcomes Suction Lift Limitations	Scan	2/24	37	(0.7)
Keeping Lubricants Flowing At Low Temperatures	Booser & Elwell	3/24	74	(6.0)
Lubricants	Chapter MD	6/30	232	(2.8)
Lubricating Systems	Chapter MD	6/30	238	(2.0)
Lubricating Pneumatic Systems	Olszewski & Zeno	9/8	132	(4.0)
Pneumatic Lubricators	Chapter FP	9/29	154	(0.5)
Mating Fiber Optics and Hydraulics	Dann	11/10	133	(5.0)

31. Power Sources

Mechanical Design: Let the Computer Do It	Article	10/20	174	(2.0)
Engineering Society President Calls For Sensible Energy Policy	N/T	4/7	18	(0.6)
One-In-Five Now an 'Energy' Engineer	Zimmerman	10/6	20	(2.0)
How We'll Beat the Energy Shortage	Aronson	10/6	106	(5.0)
Torque Control Optimizes Engine Performance	Scan	3/10	33	(1.0)
Electrostatic Ignition Fires Ultralean Fuel Mixtures	Scan	5/26	42	(0.6)
Pressure Monitor Evaluates Engine Performance	Scan	6/9	42	(1.0)
Engines	Chapter MD	6/30	78	(2.3)
Torque Control Optimizes Engine Performance	Scan	3/10	33	(1.0)
Pressure Monitor Evaluates Engine Performance	Scan	6/9	42	(1.0)

Engines	Chapter MD	6/30	78	(2.3
Sustained Arc Optimizes Engine Performance	Scan	7/21	46	(0.5)
Buick's Turbocharged V6	Wise	8/25	18	(3.0)
New Powerplant for Commercial Jets	N/T	5/12	6	(0.5)
Power Plant Stores Energy By Compressing Air	N/T	8/25	8	(0.8)
Free Energy Runs a Compressor	N/T	10/20	12	(0.6)
How Safe?	Wise	1/6	20	(6.0)
Breeder-Reactor Coolant Given Realistic Test	N/T	11/10	18	(0.7)
Designate Now Alternate Airliner Fuel	N/T	1/6	18	(0.6)
Cheap Coal Converted into Acceptable Fuel Gas	N/T	5/26	18	(1.0)
New Look To Be Taken at Three 'Odd-Ball' Energy Sources	N/T	2/10	18	(0.8)
Three Companies Compete In Designing 10/MW Pilot Plant	Article	2/10	30	(3.0)
Solar Energy on a Grand Scale	N/T	2/24	10	(0.5)
ERDA Offers Money for Solar Heating/Cooling Ideas	N/T	5/12	6	(0.5)
Outfit Your Home with a Solar Water Heater?	N/T	5/12	12	(1.0)
Big Ranch Runs Irrigation Pump on Solar Energy	N/T	5/26	6	(0.8)
'Free' And Renewable Energy Sources	Wise	5/26	22	(6.0)
Solar Energy: The Seven-Percent Solution	Aronson & Zimmerman	6/9	20	(9.0)
Sea Water: The Energy Elixir	Zimmerman	7/7	20	(6.0)
Wind Energy: Bounty in the Breeze	Wise	8/11	20	(6.0)
Bobbing Generator Runs on Ocean Waves	Scan	8/11	44	(0.5)
Tomorrow's Engineers Tackle Today's Energy Problems	N/T	8/25	22	(1.0)
Tapping Nature's Boiler Room	Aronson	9/8	28	(6.0)
'King of Beers' To Be Sun-Heat Pasteurized	N/T	10/6	6	(0.7)
Tilting Windmill Limits Blade Stresses	Scan	10/6	44	(0.5)
Liquid Lenses Focus Sun's Rays	Scan	11/10	54	(0.5)
Solar Cells Powering Remote Weather Stations	N/T	12/8	18	(0.8)
MHD Program Entering Systems-Trial Phase	N/T	4/7	12	(0.5)
Free Heat Turns 'Wonder Wheel'	N/T	4/21	10	(0.7)
Free Energy 6: Bioconversion—Harvest Time for Energy Crops	Wise	10/20	20	(6.0)

32, 33, 34. Drives, Transmissions, Drive Components

Selecting Speed Reducers—Part 1: Basic Criteria	Will	9/8	116	(5.0)
Selecting Speed Reducers—Part 2: Beyond Load Ratings	Will	9/22	104	(5.0)
Adjustable-Speed Drives	Chapter MD	6/30	8	(5.8)
Adjustable-Speed Chain Drives	Merkert	8/11	96	(5.0)
Belt Drives That Shift Themselves	Krouse	8/25	88	(5.0)
Sliding Cones Shift Stern Drive Silently	Scan	4/21	69	(1.0)
Torque Studies Result in Improved Auto Timing Chains	N/T	1/6	10	(0.8)
Chains	Chapter MD	6/30	20	(2.3)
Stationary Block Takes Up Drive Chain Slack	Scan	9/8	56	(0.5)
Straight Talk About Belt Drives	Erickson	4/21	199	(7.0)
Preventing Belt Vibration	Rao	5/26	112	(1.0)
Belt Drives	Chapter MD	6/30	26	(4.7)
'Rube Goldberg' Winner Designs a Better Mousetrap	N/T	12/8	12	(0.5)
Thermoplastic Gears	Shanley & Lamond	1/6	75	(4.0)
Correcting Friction Factors For Gear Profile Error	Rao	4/21	272	(1.3)
Boosting Gear Life Through Shot-Peening	Daly	5/12	84	(4.0)
Gears and Gear Drives	Chapter MD	6/30	13	(7.1)
Planetary Gear Trains Made Simpler	Johnson	7/21	98	(2.0)
Gear Surface Durability	Article	12/8	191	(1.2)
Restrained Pulley Gives Descending Loads Soft Ride	Scan	3/24	42	(0.6)

35. Rotational Components

Bearings	Chapter MD	6/30	165	(3.5)
Finding Bearing Life the Easy Way	Dykstra	2/24	85	(3.0)
The Hidden Cause of Bearing Failure	Kannel & Snediker	4/7	78	(5.0)
Bearing Mount Boosts Holding Power	Scan	6/23	36	(1.0)
Rolling-Element Bearings	Chapter MD	6/30	180	(12.3)
Premounted Bearings	Chapter MD	6/30	203	(1.6)
Specialty Bearings	Chapter MD	6/30	211	(9.8)
Quick-Disconnect Bearing Provides 60-Second Crane Liftoff	Scan	11/10	52	(0.7)
Floating Shoes Form Big Bearings	Scan	11/24	37	(1.0)
Plain Bearings	Chapter MD	6/30	168	(6.0)
Sliding-Bearing Materials	Chapter MD	6/30	174	(5.8)
Indicator Pin Shows Ball-Joint Wear	Scan	7/7	40	(0.5)
Teflon-Fabric Bearings	Harris	7/7	88	(4.0)
Self-Lubricating Bearings	Cooper	11/24	81	(5.0)
Sizing Shear Couplings	Ricker	5/12	91	(2.0)
Tracking Down the Cause of Coupling Failure	Wright	6/23	98	(5.0)
Couplings	Chapter MD	6/30	56	(2.7)
Universal Joints	Chapter MD	6/30	63	(1.9)
Auxiliary Components	Chapter MD	6/30	69	(4.2)
Clutch Kicks in Flywheel's Energy to Launch the Navy's Planes	N/T	2/10	6	(0.7)
Vacuum Clutch Does a Quick Step	Scan	6/9	48	(1.0)
Mechanical Systems 1977	Chapter MD	6/30	2	(6.0)
Clutches and Brakes	Chapter MD	6/30	40	(6.9)
Falling Plates Adjust Brake Shoes	Scan	10/20	56	(0.6)
Balls in Pockets Multiply Torque in Shockless Clutch	Scan	11/10	50	(0.5)
Better and Lighter Brakes	Curry	11/10	140	(5.0)
Soft-Start Couplings	Krouse	12/8	171	(5.0)

36, 37. Mechanisms, Controls

Auxiliary Components	Chapter MD	6/30	69	(4.2)
Linkage Analysis	Davidson	6/9	93	(5.0)
Five-Axis Encoding System Transmits 3-D Tube Profiles	Scan	1/6	42	(0.6)
'Bionic Bug' Walks on 'Anesthetized Feet'	N/T	3/10	4	(0.8)
Spinning Balls Govern Air Motor Speed	Scan	6/23	40	(0.5)
Torque Studies Result in Improved Auto Timing Chains	N/T	1/6	10	(0.8)
Deflecting Disc Senses Gyroscopic Torque	Scan	4/7	36	(1.0)
Solar-System Hardware Tested by NASA	N/T	2/10	4	(0.6)

39. Systems

Catastrophe Theory: Predicting the Unpredictable	Woodcock	2/10	86	(6.0)

ASSEMBLY COMPONENTS

41, 42, 43. Fasteners, Springs & Isolation Devices, Misc.

The Fastener Industry/77: Fighting Back Against Imports	Chapter F&J	11/17	2	(2.0)
Welded Fasteners	Chapter F&J	11/17	24	(3.1)
Automatic Assembly	Chapter F&J	11/17	73	(1.2)
Coldworking Boosts Fatigue Life of Fastener Holes	Article	12/8	186	(1.5)
Boss and Fastener Design for SMC Parts	Article	12/8	187	(1.2)
Adjustable Locknut Eliminates Thread Clearances	Scan	7/7	38	(0.6)
Nuts and Inserts	Chapter F&J	11/17	14	(7.6)
Quick-Operating Fasteners	Chapter F&J	11/17	118	(2.8)
Retaining Rings	Chapter F&J	11/17	90	(4.3)
Boosting the Strength of Blind-Riveted Joints	Spector	11/10	138	(2.0)
Rivets	Chapter F&J	11/17	81	(4.5)
Pins	Chapter F&J	11/17	85	(1.6)
Heavy-Duty Thread Locking	Strasser	1/20	145	(0.6)
Specifying Easy-To-Tap Threads	Jedlicka	5/12	93	(2.0)
Single System Assured for International Metric Fastener Standards	N/T	9/8	12	(0.7)
Bolts, Screws, and Studs	Chapter F&J	11/17	4	(7.3)
Fastener Preload	Chapter F&J	11/17	66	(2.0)
Materials	Chapter F&J	11/17	68	(5.8)
Jamming Threads to Keep Them Tight	Strasser	12/8	188	(1.3)
Load-Indicating Washers	Article	9/8	144	(2.0)
Washers	Chapter F&J	11/17	99	(1.6)
Resin-Filled Sausages Anchor Roof Bolts	Scan	1/6	44	(0.5)
Snap Fasteners Secure Sink to Countertop	Scan	7/7	42	(0.6)
Stamped Spring-Steel Fasteners	Chapter F&J	11/17	113	(3.5)
Plastic Fasteners	Chapter F&J	11/17	122	(2.8)
Self-Sealing Fasteners	Chapter F&J	11/17	126	(1.1)
Formed Metal Fasteners	Chapter F&J	11/17	128	(0.8)
Specifying Springs	Sharpless	1/20	138	(4.0)
Minimizing Spring Costs	Rao	7/21	120	(1.0)
Minimizing Spring Volume	Spotts	6/9	111	(1.3)
'Metal-Cutting' Energy Absorbers	Kirk & Gay	3/10	84	(2.0)
Controlled, Linear Deceleration With Shock Absorbers	Chorkey	4/7	72	(6.0)
Shock Absorbers	Chapter FP	9/29	194	(1.4)
One-Shot Shock Absorbers	Kirk & Overway	10/20	152	(6.0)
The Label . . . More Than Meets the Eye	Burghoff	4/21	206	(6.0)
Don't Machine It . . . Shim It	Errico	5/26	92	(5.0)

MATERIALS

51, 52. Ferrous, Nonferrous Metals

What's Ahead for Materials and Processes?	N/T	2/10	10	(1.7)
Design It Lighter	Bittence	2/10	102	(6.0)
MATERIALS 1977: The Supply/Demand/Cost Picture	Chapter M	3/17	2	(4.0)
Detroit Puts Materials on a Diet	Article	10/20	179	(2.0)
Ferrous Metals	Chapter M	3/17	6	(20.0)
'Electrical Steels' Save Energy	Bittence	9/8	136	(6.0)
Specialty Stainless Steels Meet Special Needs	Bittence	2/24	88	(6.0)
Sports Car to Show Brushed Stainless Body	N/T	8/11	4	(0.7)
Nonferrous Metals	Chapter M	3/17	60	(18.5)
Refractory Hard Metals	Chapter M	3/17	219	(0.6)

53, 54. Plastics, Rubber & Elastomer

Plastics	Chapter M	3/17	102	(44.7)
Thermoplastic Gears	Shanley & Lamond	1/6	75	(4.0)
Flame-Retardant Plastics	Lindstrom, Sidman & Lanzon	7/7	83	(5.0)
Polycarbonate Windshields Join the Air Force	N/T	9/22	12	(0.6)
'Snappy' Sawhorse Pultruded from Plastic	Scan	11/10	54	(0.5)
Aramid-Reinforced Polyester Provides Racer's Edge	N/T	10/20	10	(0.7)
FRP Prototypes Produced Accurately, Quickly, and Inexpensively	N/T	12/8	8	(0.9)
Structural SMC Aims at Automotive Market	Dreger	12/8	44	(3.0)
Elastomers	Chapter M	3/17	194	(5.5)
Designing With Rubber: Part 1—The Design Surface	Nagel	6/23	84	(5.0)
Designing With Rubber: Part 2—Parts In Tension or Compression	Nagel	7/7	78	(5.0)
Designing With Rubber: Part 3—Parts In Shear or Torsion	Nagel	7/21	100	(6.0)
Designing With Rubber: Part 4—Some "Real-Life" Applications	Nagel	8/11	101	(6.0)
Reinforced RIM Parts: New Possibility for Designers	N/T	11/24	4	(1.0)

55, 56. Joining Materials, Other Nonmetals

Anaerobic Gaskets Seal and Strengthen Tractor Castings	N/T	6/23	6	(1.0)
Sealants	Chapter MD	6/30	296	(2.3)
Adhesives	Chapter F&J	11/17	158	(5.8)
Adhesives That Can Live With Oil	Graham	12/8	183	(3.0)
Metallic Glass Available as Superior Brazing Metal	N/T	10/20	6	(0.5)
Fast Growth Predicted For Graphite Fibers	N/T	3/10	10	(0.6)
Other Engineering Materials	Chapter M	3/17	212	(1.6)
Long Glass Fibers Are Stronger Than Steel	N/T	1/6	4	(0.6)
Insulating Tiles Tailored to Space Shuttle's Skin	N/T	3/10	12	(0.7)
Ceramics	Chapter M	3/17	213	(1.0)
Glass	Chapter M	3/17	218	(1.1)
Many Jobs Opening for Machinable Glass-Ceramic	N/T	8/25	10	(0.8)
Intricate Glass Parts From 'PM' Techniques	Simpson	9/8	129	(3.0)
New Glasses Coming for Laser Fusion	N/T	10/6	12	(0.8)
Sorting Out the Ceramics	Bittence	12/8	176	(7.0)
Fibers	Chapter M	3/17	214	(1.3)
Rating Engineering Fabrics	Alley & McHatton	9/22	109	(4.0)
Liquid Crystals Bend Laser Beam	N/T	1/6	40	(0.5)
Microtag Can Furnish 'Fingerprint'	N/T	6/9	10	(0.9)

57. Finishes, Coatings, Lubricants

Coatings That Fight Wear	Dann	4/21	222	(5.0)
A Chromium-Like Finish—For Less	Dreger	8/25	99	(1.3)
Semiconductor Technique Now to Plate Auto Parts	N/T	11/24	18	(0.8)
Diamond-Studded Coatings Improve Part Life	Dreger	11/24	95	(3.0)
Coating Protects Transparent Plastics	N/T	3/10	8	(0.5)
Silicone Shields HVDC Insulators from Smog	N/T	8/25	4	(0.7)
Slippery, Steel-Hard Coatings for Metals	Covino	8/25	75	(5.0)
Flexible Capacitor Measures Surface Roughness	Scan	2/10	46	(1.0)

MANUFACTURING PROCESSES

58. Prefabricated Forms

Clad-Metal Trim Solves Auto Rust Problem	N/T	4/7	6	(0.6)
Clad Insert Stops Corrosion at Dissimilar-Metal Joints	N/T	7/7	10	(1.0)
Air Space Inside Foam Holding Consumer Products	N/T	9/8	10	(0.5)

61, 62, 63. Metals Casting, Shaping, Forming

What's Ahead for Materials and Processes?	N/T	2/10	10	(1.7)
Design It Lighter	Bittence	2/10	102	(6.0)
Significant Changes Coming in Manufacturing	N/T	7/7	6	(0.8)
Injected-Metal Assembly	Chapter F&J	11/17	157	(0.5)
Spin Forging Cuts Steel Input 75%	N/T	1/20	10	(1.0)
Split Dies Make 'Impossible' PM Parts	Dreger	7/21	95	(3.0)
Cutting Sheet-Metal Corners	Strasser	4/21	273	(1.4)
Three-in-One Metal Fabricator Boosts Productivity	Scan	8/11	46	(0.6)
Spin Forging Cuts Steel Input 75%	N/T	1/20	10	(1.0)
Metal Spinning Streamlines Frigate	N/T	1/20	12	(0.5)
Metal Spinning Broadens Capabilities	Geckler	9/22	92	(4.0)

64, 65. Metal Joining, Removal

Welding Processes	Chapter F&J	11/17	149	(3.3)
Brazing Processes	Chapter F&J	11/17	152	(3.2)
Soldering Processes	Chapter F&J	11/17	155	(2.1)
Narrow-Gap Welding Joins Thick Sections	N/T	5/26	12	(0.6)
New HF Melt Welding Produces Less-Visible Spots	N/T	8/11	10	(0.8)
Detergent Cleans Up Stud Welding	Scan	8/25	46	(0.5)
Melt-Welding Challenges Spotwelding	Article	10/20	192	(2.0)
Ultrasonic Welding Finding Favor Among Small-Motor Makers	N/T	10/6	32	(0.7)
IC Extraction Tool Desolders Dead DIPs	Scan	1/6	38	(1.0)
Designing to Reduce Machining Costs	Strasser	1/6	88	(4.0)
EDM Goes Into Orbit	Dreger	4/21	218	(4.0)

66. Metal Testing

Heating Element Hardens Metal Surfaces	Scan	7/7	40	(0.5)

67, 68. Finishing, Plastics & Rubber Processes

Line-Forming Technique Promises New Electronic Devices	N/T	1/20	4	(0.7)
Water-Cooled Gun Cuts Plasma Coating Costs	Scan	2/10	40	(1.0)
Air Sprayer Metallizes Plastic	Scan	9/22	42	(0.5)
Impregnation Comes Out of the Closet	Wiley	11/10	128	(5.0)
Pultrusions Step Up the Challenge to Structural Steels	Tickle	10/20	163	(5.0)
Weld Joints for Plastics	Bongo	4/21	275	(1.0)
Plastic Joining	Chapter F&J	11/17	163	(2.3)
Rubber-Mold Spin-Casting	Schaer	1/20	113	(5.0)

69. General

TV Camera Eliminates Mask in IC Production	Scan	9/8	54	(0.5)

DESIGN THEORY & TECHNIQUES

71, 72, 73. Mechanics, Strength of Materials and Parts

Elastodynamic Balancing of Machines	Rao	1/6	92	(1.3)
Quick Test Gives Stress Concentration Factors	McGivern & Shirk	4/21	269	(1.0)
Stresses in Spherical Caps	Tabakman	3/10	79	(4.0)
Predicting Impact Wear	Engel	5/26	100	(6.0)
Combining Moments of Inertia	Steinberg	2/10	118	(2.0)
Guarding Against Fatigue Failure in Press-Fitted Shafts	Sullivan	6/9	102	(5.0)
Optimizing Bracket Shape	Strasser	10/20	191	(1.0)
Buckling of Complex Columns	Castleberry	3/24	94	(1.5)
Torsional Stresses in Slotted Shafts	Isakower & Barnas	9/22	100	(4.0)
Limits on Compressive Stress	Motley	6/23	103	(1.4)

74. Human-Factors Engineering

How Safe?	Wise	1/6	20	(6.0)
The Isle for Science	Aronson	2/10	22	(4.0)
Designing Accident-Proof Operator Controls	Meagher	6/23	80	(4.0)

75. Design Analysis & Synthesis

The Search for Credible Design Data	Barrett	4/21	260	(5.0)
Volume and C G of Pipe Intersections	Johnson	9/8	142	(2.0)
Forecasts from Limited Data	Ferris-Prabhu	1/20	123	(7.0)
Predicting Product Life	Ferris-Prabhu	10/20	158	(5.0)
Simplified Interpolation	Vitek	11/10	148	(0.7)
Simplified Random Sampling	Article	11/24	101	(2.0)
Finding Averages Quickly	Zanker	1/6	93	(1.7)
Forecasts from Limited Data	Ferris-Prabhu	1/20	123	(7.0)
Catastrophe Theory: Predicting the Unpredictable	Woodcock	2/10	86	(6.0)
Calculator Makes 3-D Views Easier	Kuyt	3/24	89	(5.0)
Simulating Intelligence	Appel	12/8	148	(8.0)
Specifying Dimensions Over Pins and Balls	Franks	3/10	83	(1.0)
Running the Risk of Interference Fits	Spotts	7/21	106	(6.0)

76. Basic Sciences & Fields

Chosen Atoms Singled Out and Watched	N/T	1/20	12	(0.5)
Evidence for Fractional Charge Hints Quark May Exist	N/T	5/26	4	(0.6)
Six Ways to Cope With Thermal Expansion	Tromel	2/10	92	(5.0)
Ultrasonic Echoes Check Concentricity of Gundrilled Shaft	Scan	2/10	42	(0.5)
Heat-Produced Ultrasonics: New Tool for Flaw Detection	N/T	5/12	8	(0.7)
Ultrasonic Monitor Measures Crack Growth	Scan	5/12	44	(0.6)
Ultrasonics Tell the Inside Story	Aronson	5/12	76	(6.0)
Aerodynamics at Indy	Wise	5/12	20	(6.0)
Big-Aircraft Drag Reducers to be Tested	N/T	7/7	12	(0.6)
The X-Wing: Designed for the 'Sometimes It's a Helicopter Jetliner'	N/T	8/11	8	(0.8)
Fan Ready for Passenger-Car Wind Tunnel	N/T	9/8	4	(0.5)

77. Experimental Design

Shock Tube Provides Turbine-Wear Data	N/T	6/23	8	(0.5)
Static Forces Simulate Dynamic Tire Loads	Scan	9/8	56	(0.5)
Unique Experimentation Strategy Lets You TEST LESS, LEARN MORE	Geremia	9/8	110	(6.0)
Product Testing	Kirkham	11/10	120	(3.0)
Ultrasonics Takes on Fracture-Toughness Testing	Vary	11/10	145	(2.0)

78. Environmental Design

Next Mars Landers May Go Over the Hill	N/T	1/6	6	(0.6)
NASA's 1977 Launch Schedule	N/T	2/10	26	(0.8)
Shuttle Orbiter Poised for Free-Flight Tests	Zimmerman	7/21	20	(3.0)
Asteroid Mining Might be Feasible: Search On for Near-Earth Targets	N/T	11/10	26	(0.7)
Three Tools Resulting from One Idea	N/T	7/21	4	(0.8)
Aerial Photos to Catch Polluters Polluting	N/T	3/24	12	(0.5)
Indoor Air Quality Often Poor	N/T	6/23	4	(0.5)
Economic Growth Tied to Auto Pollution	N/T	7/21	10	(0.5)
Milwaukee Recycling All Its Trash	N/T	6/23	10	(0.8)
Products from Recycled Rubber Will Cost Less, Perform Well	N/T	7/21	10	(0.5)
Effectiveness of Attic Ventilators and Fans Probed	N/T	9/8	8	(0.6)
Old-Tire Reef Reviving Game Fishing	N/T	10/20	4	(0.7)

ENGINEERING MANAGEMENT & OPERATION

81. Engineering Department Operations

Good News About America's Technology	Dann	10/6	86	(5.0)
What the World Wants	Dreger	10/6	91	(5.0)
Why We'll Stay Ahead	Aronson	10/6	101	(5.0)
Getting Ahead in Engineering	Zimmerman	2/10	82	(4.0)
ICAM: Revolution in Manufacturing	Zimmerman	5/26	86	(6.0)
Making Meetings Count	Fuller	11/10	116	(4.0)
R&D Funding Up for '77	N/T	1/20	8	(0.5)
Project Budget Overruns	Steinmetz	3/10	58	(4.0)
What You Should Know About Financial Analysis	Reilly	8/11	76	(5.0)
NASA's 1977 Launch Schedule	N/T	2/10	26	(0.8)
How to Keep a Project On Schedule	Shane	3/24	68	(3.0)
Project Planning Made Simple	Birnbrauer	5/12	66	(5.0)
How Russia Uses and 'Abuses' Engineering Manpower	Zimmerman	11/24	20	(6.0)
Motivating the Engineer: The Direct Approach is Best	Raudsepp	11/24	78	(3.0)
Engineer Supply/Demand: NSF Looks to 1985	Zimmerman	1/20	30	(4.0)
Taking the Sting Out of Performance Reviews	Birnbrauer	9/8	106	(4.0)
Measuring Managerial Effectiveness	Fuller	1/20	108	(5.0)
Engineers Spark Manager Mart While Companies Often Prefer Others in Top Spots	N/T	12/8	37	(1.0)
Picture Brightens for Engineering Salaries	Zimmerman	4/21	190	(6.0)
Companies Up Ante For '77 Engineering Grads	Zimmerman	5/12	28	(3.0)
Technicians' Salaries: More 'Real' Money Only for the Young	N/T	11/24	12	(1.0)
Heading Off Objections to Your Proposals	Fuller	6/23	76	(4.0)

82, 83. New Product Development, Drafting & Reproduction

R&D Funding Up for '77	N/T	1/20	8	(0.5)
Has NASA Already Solved Your Next Design Problem?	Aronson	3/10	18	(5.0)
Profits Fuel Innovation	Comella	10/6	96	(5.0)
Putting a New Product On Stream	Gronseth	11/24	103	(2.0)
Engineering Department Layout—Enter The Landscaper	Wise	2/24	100	(4.0)
Drafting Equipment—New Tools Boost Efficiency	Zimmerman	2/24	104	(5.0)
Drafting Media—Film and Paper Fight It Out	Beercheck	2/24	109	(4.0)
Reproduction Equipment—When Once Is Not Enough	Dann	2/24	113	(5.0)
Justifying the Switch to Microfilm	Kelly	8/25	93	(5.0)

84. Laboratory & Testing

Forecasts from Limited Data	Ferris-Prabhu	1/20	123	(7.0)
Ultrasonic Monitor Measures Crack Growth	Scan	5/12	44	(0.6)

85. Technical Information

Specifying Springs	Sharpless	1/20	138	(4.0)
ANSI Sees Standards 'Iron Curtain' In U.S.	N/T	10/20	8	(0.8)
Parts Coding Cuts Costs	Bobrowicz	9/22	82	(5.0)

86, 87. Patents & Patent Law, Personnel & Professional

More 'Clout' for Patents	Burge	10/20	142	(4.0)
Is Anybody Listening?	Raudsepp	2/24	82	(3.0)
Coping With Job-Related Stress	Robinson & Thompson	5/26	82	(4.0)
How To Get Along With Your New Boss	Gibson	8/11	108	(2.0)
Engineer Demand: Telltale Clue of Economic Health?	Zimmerman	11/10	20	(5.0)
The Isle For Science	Aronson	2/10	22	(4.0)
Getting Ahead in Engineering	Zimmerman	2/10	82	(4.0)
Games That Stimulate Creativity	Raudsepp	7/21	88	(7.0)
26th WESCON: Short But Big in San Francisco, Sept. 19-21	N/T	9/8	36	(4.0)
Triple Engineering Shows and Conferences Move to Chicago, Oct. 25-27	Article	10/20	172	(2.0)
Screen Test For LeMouse II	Article	1/20	22	(4.0)
The Thrill of Victory and the Agony of Defeat at the Great Clock Climb	Aronson	6/23	18	(7.0)
Prepping for the P.E. Exam	Constance	1/6	66	(4.0)
Documenting Your P.E. Qualifications	Constance	4/21	196	(3.0)
Rx for Engineering Ills?	Zimmerman	8/25	70	(5.0)
Fed's Study of Product-Liability Law Suggests 'Refinements'	N/T	5/12	4	(0.8)
The Expert Witness	Aronson	7/7	64	(4.0)
Huge Product-Liability Awards Predicted for Europe	N/T	11/10	10	(0.9)
Insurance Companies Report on Product Liability Claims	N/T	11/24	6	(0.6)
Product-Liability Task Force Reports Its Findings	N/T	12/8	12	(0.5)
Coping With Neophobia	Raudsepp	4/7	62	(3.0)

88. Outside Services

What Can a Management Consultant Do For You?	Karger	6/9	86	(3.0)

COMPLETE MACHINES

910. General

Strong Pulse from the Heart of Industry	Bittence & Beercheck	10/6	120	(9.0)
Design Imperatives, 1977	Herzog	12/8	138	(10.0)

911. Ordnance

RPV Flys Automatic Flight	N/T	1/6	8	(0.8)
Cannon Projectile Shatters, Doesn't Ricochet	N/T	1/20	8	(0.5)
Target Attempts to Confuse Missile	N/T	2/10	8	(0.6)
Gatling Gun Made More Lethal	N/T	3/24	4	(0.6)
Laser-Guided Bomb Hitting All Its Targets	N/T	9/22	8	(0.7)

912. Machinery

Steel Belt Conveys Destination Codes	Scan	5/12	40	(1.0)
Rotary Cutter Slashes Metal Removal Rates	Scan	5/12	42	(0.5)
A Fresh Look at Fire Fighting	Aronson	5/26	32	(4.0)
Air Bag Tested as Building Foundation	N/T	7/7	8	(0.5)
To Avoid Global Famine, Gear Up U.S. R&D Now	N/T	8/25	12	(0.6)
Melding Genetics with Mechanics	N/T	10/6	23	(1.0)
90-Ton 'Superdozer' Shows Different Profile	N/T	11/10	4	(1.0)
1-Week Mine Rescues 1,000-ft Down Now Seen Feasible	N/T	11/10	8	(1.0)

913. Electrical Machinery

Postal Service Going Out of Business?	N/T	3/24	18	(0.6)
Researchers Watching Soap Operas on Thin-Film TV	N/T	4/21	16	(1.2)
Weather Effects on Millimeter Waves Studied	N/T	6/9	12	(0.5)
Save Energy by Designing for Dunderheads	N/T	6/9	12	(0.5)
Seafarer Given Conditional O.K.	N/T	9/8	4	(0.5)
Motorized Carrier Adds Motion to Slide Shows	Scan	11/10	50	(0.5)

914. Transportation

Next Mars Landers May Go Over the Hill	N/T	1/6	6	(0.6)
F-15 Quieted on the Ground	N/T	2/24	8	(0.8)
Trestle Tests Aircraft in Nuclear Environment	N/T	2/24	12	(0.8)
Orbiting With Sail	Zimmerman	3/24	20	(4.0)
Will Electricity Power Tomorrow's Trains?	Aronson	4/7	20	(5.0)
The Eagle and the Foxbat	Wise	4/21	22	(4.0)
Exploring the X-Ray Sky	Zimmerman	4/21	40	(3.0)
LeBaron and Versailles Join the Growing Mid-Size Market	N/T	4/21	46	(2.0)
Assault Craft Readied for the Navy	N/T	5/12	10	(0.6)
Ford's Front-Drive Fiesta	Wise	6/9	34	(2.0)
'Air-Bag Tests Should Continue'	N/T	6/23	8	(0.5)
Orderly Evolution Seen for Jet Transports	N/T	7/7	4	(0.6)
EVs Will Roll	Wise	7/21	26	(4.0)
Germany Pushes for Higher-Speed Trains	Heumann	8/11	30	(4.0)
Voyager: Running a Planetary Post Pattern	Zimmerman	8/25	27	(4.0)
Newport's Dueling Twelves	Zimmerman	9/8	20	(4.0)
Supersonic, Canard-Type VTOL Rolled Out	N/T	9/22	4	(1.2)
Facelift at Launch Complex 39	N/T	9/22	18	(1.0)
The 1978 Cars	Wise	9/22	20	(8.0)
Blown-Wing STOLS On Trial	Aronson	10/6	26	(4.0)
DOD's Share of the Shuttle	Zimmerman	10/20	30	(3.0)
'Plunger' Replaces Canal Locks	Scan	10/20	59	(0.6)
Longhorn: A Business Jet in the Tropopause	N/T	11/10	6	(0.8)
Mars Tester to Penetrate 45-ft Deep	N/T	11/10	12	(0.7)
Two Cruise Missiles Vie For Robot-Bomber Role	N/T	11/10	30	(4.0)
Lockheed Studying Hypersonic Transport	N/T	11/24	8	(0.6)
Active Ailerons to Control New TriStars	N/T	12/8	4	(0.8)
America's First Front-Drive Subcompact	Wise	12/8	30	(3.0)
Aluminum Bogie Suspends Rail-Car Sway	Scan	12/8	60	(0.6)

915. Instruments

Dime-Size Area Holds Whole Bible	N/T	3/10	6	(0.7)
Water Conductivity Detects Contaminated Metal	Scan	6/23	40	(0.5)
Vocally Handicapped Get Two New Communicators	N/T	12/8	39	(1.5)

917. Leisure and Hobby

The Compound Bow: Ugly But Effective	Aronson	11/10	38	(3.0)

CLASSIFICATION SYSTEM

The classification system provides nine major (one-digit) classifications, each of which has up to nine (two-digit) sub-classifications. These, in turn, are divided into ten (three-digit) indexing classifications.

Indexing classifications ending in 0 (General) are used to index material concerning several or all indexing classifications ending in 1 through 8. Classifications ending in 9 (Other) are used for material falling within the sub-classification but not within any of the items 1 through 8.

1—ELECTRICAL AND ELECTRONIC

11 Motors
110 General
111 Fractional (less than 1 hp)
112 Ac integral horsepower, induction
113 Dc integral horsepower
114 Universal (dc or ac)
115 Multispeed
116 Gearmotor
117 Torque
118 Definite and special purpose, pancake
119 Other: Linear, motor protectors

12 Power Supplies
120 General
121 Batteries, battery chargers, battery holders
122 Dc generators, motor-generators
123 Ac generators, motor-generators, alternators
124 Converters, inverters
125 Transformers, voltage regulators
126 Fuel cells, solar cells, photo cells
127 Thermoelectric supplies
128 Antennas
129 Other

13 Switches and Relays
130 General
131 Mechanical: Pushbutton, toggle, rotary, acceleration
132 Thermally operated: Thermostats, thermistors
133 Pressure operated
134 Limit, snap-action
135 Proximity, photoelectric, magnetic, Hall effect
136 Stepping
137 Relays, circuit breakers
138 Motor starters, motor controls, contactors, starting reactors
139 Other: Reed, mercury-wetted

14 Instruments and Controls
140 General
141 Sensing devices, transducers, thermocouples
142 Solenoids, electric actuators
143 Timers, timing motors, delays
144 Synchros
145 Instrument motors, synchronous
146 Data recorders, readouts, indicators, displays, memories
147 Meters, gages
148 Servo motors, stepping motors
149 Other: Motor silencers

15 Circuit Components
150 General
151 Resistors, varistors, rheostats, potentiometers
152 Capacitors
153 Inductors
154 Solid-state devices: Diodes, transistors, thyristors, SCR's, rectifiers, semiconductors, optical couplers, integrated circuits
155 Tubes, cathode ray tubes
156 Saturable reactors, magnetic amplifiers
157 Fuses, fuse panels, protectors
158 Lasers, masers
159 Other

16 Connectors and Wiring
160 General
161 Rings, brushes, commutators, rotors
162 Terminals, binding posts, terminal boards
163 Contacts, button
164 Plugs, receptacles, connectors, sockets
165 Wiring, cable, cord, harness, bus bars, coaxial, circuits, grounding
166 Printed circuits, stitched circuits
167 Superconductors
168
169 Other: Lenses, mirrors, reticles, reflectors, prisms, photosensors

17 Miscellaneous Components
170 General
171 Magnets, electromagnets
172 Chassis, control panels, keyboards
173 Insulation, encapsulation, shielding, jacketing, conduit
174 Cooling elements
175 Lamps, lighting elements, fiber optics, strobes
176 Heaters, heating elements, ovens
177 Electric clutches, electric brakes
178 Ignition systems
179 Other

19 Systems & Assemblies
190 General
191 Amplifiers, preamps
192 Control systems: Regulators, numerical control, digital controllers
193 Electronic computers, calculators, peripheral equipment
194 Microprocessors
195 Adjustable-speed drives
196 Servomechanisms
197
198 Packaging (electrical/electronic)
199 Other

2—FLUID POWER

21 Fluids
210 General
211 Hydraulic fluids
212 Coolants, refrigerants
213 Cleaners, solvents (see 577)
214 Lubricants (see 576)
215
216
217
218 Aerosols, pressurized liquids
219 Other

22 Fluid Conditioners
220 General
221 Fluid storage, pressure vessels, reservoirs
222 Filters, strainers, screens, baffles
223 Renovators (Note, 223 = 222 + 286 + 296)
224 Heat exchangers
225 Coolers, radiators, heat pipes
226 Heaters, burners
227 Driers, evaporators
228 Humidifiers, mixers, carburetors
229 Other

23 Fluid Conductors
230 General
231 Tubing (pressure) (see 587)
232 Hose, ducts, bellows
233 Pipe
234 Fittings
235 Joints, couplings, unions, flanges, adapters
236 Mufflers
237 Hydrofoils
238
239 Other: Applicators, dispensers, reversers

24 Linear Devices
240 General
241 Cylinders, pistons, cylinder mounts
242 Accumulators
243 Intensifiers, boosters, rams
244 Actuators, bellows, diaphragms
245 Pumps
246 Motors
247
248 Compensators
249 Other: Impellers, air guns

25 Rotary Devices
250 General
251 Pumps, rotary, centrifugal
252 Fluid motors, brakes, high-torque low-speed
253 Air motors
254 Compressors
255 Rotary actuators
256 Winches
257 Propellers (see 357)
258 Centrifuges
259 Other

2—FLUID POWER (continued)

26 Seals
260 General
261 Material seals (O-ring)
262 Mechanical seals
263 Gaskets
264 Wiper rings, piston rings
265 Packings
266 Labyrinths
267
268 Bellows, protective covers
269 Other: Diaphragms, rolling diaphragms, closures, plugs

27 Valves
270 General
271 Directional control
272 Flow control, faucets, flow dividers
273 Pressure control, relief vacuum breakers
274 Servo valves
275 Valve blocks, manifolds
276 Nozzles, venturies, orifices, poppets
277 Proportional flow or pressure
278
279 Other

28 Instruments & Controls
280 General
281 Test stands
282 Control panels
283 Meters, gages: Manometers, flow meters, rotameters, anemometers
284 Switches, liquid level
285 Transducers (to hydraulic)
286 Regulators
287 Fluid logic, fluidics, moving-part logic
288
289 Other: Floats, anchors

29 Systems & Assemblies
290 General
291 Industrial hydraulic & pneumatic systems
292 Mobile, aircraft, marine
293 Hydrodynamic drives
294 Hydrostatic drives
295 Vacuum
296 Lubrication
297 Hydraulic, pneumatic computers
298 Power units
299 Other: Servo systems

3—MECHANICAL

31 Power Sources
310 General, energy
311 Jet engines
312 Internal combustion engines
313 Turbines, turbofans, turbojets
314 Atomic, nuclear power
315 Exotic fuel engines, rockets
316 Fuels, propellants, explosives, coal, natural gas, hydrogen, fuel oil
317 Steam
318 Geothermal, wind, water, solar, tidal
319 Other

32 Constant-Speed Drives & Transmissions
320 General: Speed reducers
321 Chain
322 Belt
323 Friction: Ball, disc, wheel, cone
324 Gear
325
326
327
328
329 Other: Reversing

33 Adjustable-Speed Drives & Transmissions
330 General: Speed reducers
331 Chain
332 Belt
333 Friction: Ball, disc, wheel, cone
334 Gear
335
336
337
338
339 Other: Reversing

34 Drive Components
340 General
341 Transmission chain, cable, cable fittings, cable splices, shackles
342 Belts, belting
343 Gears, gearing, racks, pinions
344 Sprockets
345 Pulleys, sheaves, idlers, tensioners
346 Conveyor chain, conveyor belts
347 Conveyor screws, roller conveyors
348
349 Other

35 Rotational Components
350 General
351 Antifriction bearings: Ball, roller, needle, linear, thrust, pillow blocks
352 Sleeve bearings: Gas, solid-lubricant, bushings, rod ends, ball joints
353 Flexible couplings, universal joints, flexible shafts
354 Torque converters, fluid couplings
355 Shafts, axles, splines, crankshafts, spindles
356 Clutches, brakes, power absorbers, torque limiters
357 Fans, blowers, propellers (see 257)
358 Reels, winches, hoists
359 Other: Flywheels

36 Mechanisms
360 General
361 Cams, cam followers
362 Linkages, cranks
363 Intermittent-motion, periodic-motion, indexing, gyratory-motion, mechanical escapements, ratchets
364 Three-dimensional
365 Motion converters, leadscrews, jacks, actuators
366 Spring motors
367 Telescoping members, collapsing members
368 Manipulators, vibrators, robots, separators
369 Other

37 Controls
370 General
371 Push-pull
372 Transducers (to mechanical)
373 Gyros, gyroscopes
374 Mechanical counters
375 Safety devices, audible warning devices
376
377
378
379 Other

39 Systems
390 General

4—ASSEMBLY COMPONENTS

41 Fasteners
410 General
411 Inserts
412 Nuts, locknuts
413 Pins, dowels, staples
414 Quick operating panel-type, latches
415 Retaining rings, keys, collars, frictional shaft connectors, shaft-hub connectors, tolerance rings
416 Rivets, blind rivets
417 Screws, bolts, studs, shear bolts
418 Washers, grommets, eyelets, spacers, bushings, stand-offs
419 Other: Spring clips, clamps, zippers, wire ties, belt splicing, captive panel hardware, captive fasteners

42 Springs and Isolation Devices
420 General
421 Fluid & air springs
422 Helical wire springs
423 Leaf springs, cantilever
424 Vibration isolators, mounts
425 Hydraulic-damping devices, shock absorbers, snubbers
426 Mechanical damping devices
427 Spring-loaded devices
428
429 Other: Belleville, constant force

43 Miscellaneous
430 General
431 Locks
432 Nameplates, labels, wire markers, signs
433 Dials, knobs, handles, drawer pulls
434 Shims
435 Enclosures, housings, cabinets, cases
436 Wheels, tires, rollers, casters, ball transfers, rings
437 Slides, ways
438 Hinges, brackets
439 Other: Razor blades, brushes, bells, knives, buzzers, chimes, bases, boots, bellows, way protectors

44 Mechanical Measurement Equipment
440 General
441 Inspection tools and fixtures
442 Gage blocks, micrometer heads
443 Meters, gages

5—MATERIALS

51 Ferrous Metals
510 General
511 Cast iron, malleable iron, cast carbon, alloy steels
512 Wrought carbon, alloy steels
513 Free-machining steels
514 Stainless steels, high alloys, high temperature steels
515 Specialty steels (tool, die, electrical)
516
517 High-strength low-alloys
518 Magnetic alloys
519 Other

52 Nonferrous Metals
520 General
521 Aluminum
522 Copper, brass, bronze, beryllium copper
523 Magnesium
524 Nickel
525 Titanium
526 Zinc
527 Refractory metals: Tungsten, tantalum, molybdenum, columbium
528 Precious metals
529 Other: Tin, lead, chromium, vanadium

53 Plastics
530 General
531 Thermoplastic plastics (nylon, Teflon)
532 Thermosetting plastics (epoxy, phenolic, filled silicones, rigid urethanes)
533 Laminated plastics, vulcanized fiber
534 Reinforced, filled plastics
535 Porous plastics
536 Colors for plastics
537 Plastic trims
538
539 Other: Degradable

54 Rubber and Elastomer
540 General
541 Natural rubber
542 Synthetic rubber
543 Elastomeric plastics: Flexible silicones and urethanes
544 Hard rubber
545
546
547
548
549 Other

55 Joining Materials
550 General
551 Adhesives, sealants, encapsulants, caulking, grout
552 Welding rods
553 Brazing, soldering alloys
554
555
556
557
558
559 Other

56 Other Nonmetals
560 General
561 Carbon, graphite, diamonds
562 Glass, ceramics, quartz
563 Refractory materials, mica
564 Carbides, cermets
565 Mineral and synthetic fibers, felt, fabrics
566 Insulating materials (thermal, sound)
567 Wood, cork, composition board, paper
568 Chemicals, phosphors, inks
569 Other: Abrasives, friction materials, synthetic crystals, heat-sensitive liquid crystals

57 Finishes, Coatings & Lubricants
570 General
571 Metallic coatings
572 Chemical coatings, electrochemical coatings, photosensitive
573 Organic finishes: Lacquers, synthetic enamels, paints, varnishes
574 Porcelain enamels, vitreous coatings
575 Plastic coatings, plastic powders
576 Lubricating materials (see 214)
577 Cleaners, solvents (see 213)
578 Mechanical surface finishes
579 Other: Corrosion inhibitors

58 Prefabricated Forms
580 General
581 Film, tape, sheet, foil, plate
582 Wire, wire cloth, knitted wire mesh, wire rope, cable
583 Patterned, perforated, expanded metals, textured, prefinished
584 Laminates
585 Composite materials
586 Structures: Honeycomb, foam, sandwich, isogrids, geodesic
587 Structural shapes: Tubing, channels
588 Balls, beads
589 Other

6—MANUFACTURING PROCESSES

61 Metal Casting
610 General
611 Sand
612 Shell mold
613 Permanent mold, gravity, low-pressure
614 Centrifugal
615 Investment
616 Die
617 Plaster mold
618 Continuous
619 Other

62 Metal Shaping
620 General
621 Forging, cold forging
622 Extrusion, impact extrusion
623 Heading, upsetting, cold forming
624 Thread, form rolling
625 Powder metallurgy, porous metals, fiber metals
626
627
628 Hot isostatic pressing
629 Other

63 Metal Forming
630 General
631 Sheet forming, plate forming
632 Stamping, drawing, blanking, embossing, coining
633 High-velocity forming, explosive forming
634 Spinning
635 Roll forming
636 Tube forming
637 Wire forming
638 Stretch and compression forming
639 Other: Magnetic forming

64 Metal Joining
640 General
641 Arc welding
642 Gas welding
643 Resistance welding
644 High-energy welding: Plasma, electron beam, explosive bonding, ultrasonic, magnetic, solid state
645 Flame cutting
646 Brazing
647 Soldering, desoldering
648 Adhesive joining, bonding
649 Other: Interlocking, keylock, dove-tail, sewing, bolted joints, riveting

65 Metal Removal
650 General
651 Planing, broaching
652 Lathe turning, screw machining
653 Milling, hobbing, gear shaping, sawing
654 Drilling, boring, tapping
655 Grinding, abrasive machining
656 Honing, lapping, polishing, burnishing
657 High-energy machining: Spark, laser, water jet
658
659 Other

66 Metal Treating
660 General
661 Heat treating
662 Surface treating: Carburizing, nitriding
663 Shot peening, surface working
664 Chemical milling, etching, photochemical machining
665
666
667
668
669 Other

67 Finishing
670 General
671 Chemical, solvent cleaning
672 Mechanical finishing, tumbling
673 Conversion coating, anodizing, electropolishing
674 Electroplating, vacuum metallizing
675 Metal spraying, flame spraying, hard facing, plasma spray, plasma arc, electrostatic
676 Painting
677 Hot stamping: Branding
678
679 Other

68 Plastics & Rubber Processes
680 General
681 Molding, injection molding, forging, rotational molding
682 Extrusion, pultrusion
683 Sheet forming
684 Laminating
685 Casting
686 Stamping, machining, fabricating, forming, forging
687 Calendering, coating, plating
688 Encapsulating
689 Other: Filament winding, welding

69 Miscellaneous
690 General
691 Assembly, automatic assembly, micro-assembly
692 Packaging, storage, shipping
693 Balancing rotating machines

7—DESIGN THEORY & TECHNIQUES

71 Mechanics
710 General
711 Statics (at rest)
712 Dynamics (force to create motion)
713 Kinematics (motion in abstract)
714 Vibration, natural frequency
715 Shock
716 Noise, sound, music
717 Viscosity
718 Strain and stress
719 Other

72 Strength of Material
720 General
721 Elastic theory
722 Plastic theory
723 Fatigue, endurance
724 Creep
725 Impact stress
726 Thermal stress
727 Friction, wear
728 Fracture
729 Other: Hardness

73 Strength of Parts
730 General
731 Tension, compression
732 Bending
733 Shear, torsion
734 Surface contact stress
735 Plates
736 Cylinders, columns
737 Rotating discs, rotors
738 Critical speed, critical flow
739 Other

74 Human-Factors Engineering
740 General
741 Styling
742 Color
743 Safety, comfort, protective clothing
744 Illumination
745 Human limitations
746 Spare/replacement parts
747
748
749 Other: Tactile graphics

75 Design Analysis & Synthesis
750 General
751 Mathematical methods, statistics
752 Graphical techniques
753 Analogs, models, simulators
754 Computer techniques
755 Reliability, quality control
756 Dimensioning, tolerances
757 Maintenance
758 Value analysis
759 Other

76 Basic Sciences & Fields
760 General
761 Physics
762 Chemistry
763 Thermal, thermodynamics, cryogenics, heat transfer, combustion
764 Radiation
765 Biosciences
766 Optics, photography, holography, photoelasticity
767 Ultrasonics
768 Aerodynamics
769 Other: Economics, metrology

77 Experimental Design
770 General
771 Prototypes, breadboards
772 Testing, stress analysis
773
774
775
776
777
778
779 Other

78 Environmental Design
780 General
781 Corrosion, rust
782 Mold, fungus
783 Outer space
784 Under sea
785 Pollution
786 Waste treatment, reclamation, salvage, restoration, conservation, recycling
787
788 High temperature, low temperature
789 Other

8—ENGINEERING MANAGEMENT & OPERATION

81 Engineering Department Operation
810 General
811 Structure, organization
812 Costs, budgets
813 Programming, planning
814 Personnel policies
815 Recruiting, evaluation, training
816 Managerial talent
817 Compensation, pensions
818 Communication
819 Other

82 New Product Development
820 General

83 Drafting & Reproduction
830 General
831 Management, control systems
832 Drafting practices, techniques
833 Technical illustration
834 Drafting equipment
835 Reproduction equipment, systems
836 Furniture, drawing files
837
838
839 Other

84 Laboratory & Testing
840 General
841 Nondestructive testing
842 Dynamic analysis

85 Technical Information
850 General
851 Engineering libraries, files, books, museums
852 Information classification, retrieval
853 Specifications, standards, metrication
854 Report writing, articles, papers, oral
855 Part numbering, part names (nomenclature)
856 Engineering records
857
858 Security, protection
859 Other

86 Patents & Patent Law
860 General

87 Personal & Professional
870 General
871 Creativity, inventiveness
872 Meetings, shows
873 Contests, awards
874 Societies
875 Professional licensing, certification
876 Unions
877 Education, curriculums, seminars, career planning
878 Product litigation, expert witness
879 Other: Women

88 Outside Services
880 General
881 Engineering design services
882 Industrial design services
883 Consulting to government
884
885
886
887
888
889 Other

9—MISCELLANEOUS

91 Complete Machines
910 General
911 Ordnance: Tanks, missiles, rockets, ammunition (SIC 19)
912 Machinery: Agricultural, construction, machine tools, office machines, materials handling (SIC 35)
913 Electrical machinery: Communication, radio, radar, TV, appliances, X-ray (SIC 36)
914 Transportation: Automotive, aircraft, ships, railroad, spacecraft, undersea craft (SIC 37)
915 Instruments: Medical, dental, photographic, watches (SIC 38)
916 Fabricated metal products: Hand tools (SIC 34)
917 Toys, playground equipment, sports equipment, recreational equipment
918
919 Other

99 Unclassified
990 General